Ways of Economy of Construction Materials

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WAYS OF ECONOMIZING ON CONSTRUCTION MATERIALS

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The ever-growing scale of industrial, housing, and cultural-and-welfare construction requires a tremendous amount of construction materials. At the same time, the building-material industry, although rapidly expanding, finds itself, at times, lagging behind the every-growing day-by-day demand which, in a number of cases, prevents the timely delivery and the beginning of exploitation of important projects.

Until this day, many building organizations consume the materials that are in shortest supply, such as steel, cement, and lumber, in a wasteful manner. They use the above critical materials in places where, without any ill effects to the quality of the structure, local low-cost building materials can be utilized. An overexpenditure of materials is also caused by unnecessary superfluities in the design. Frequently, there are losses and spoilages of materials in transit and in storage, as well as excessive waste at the building sites in the shaping of structural details.

In order to overcome the above indicated wasteful practices, the State Committee of the Council of Ministers of the USSSR in Charge of Construction approved "Specifications pertaining to the economic use of metal, cement, and lumber in construction", which must be complied with in the design and in the erection of buildings and structures.

There is to be no deviation from these rules even in the

case of an abundant supply of construction materials.

The specifications are particularly strict with reference to the expenditure of steel. Accordingly, metal construction is to be used in those cases only, where no other materials will do, with quality steel used in order to reduce the weight of the structure. St. 0 steel is permitted only in non-rated structural members, the cross section of which is governed by considerations of design. Riveted structures requiring a greater expenditure of steel, as compared to welding structures, are permitted only in individual parts of the construction, which are to operate under particularly unfavorable conditions, as for instance, in crane girders carrying heavy bridge cranes (with a lifting capacity of 100 tons and over) and rigid suspension cranes. Since at the present time welded structures are primarily in use, and this practice cannot result in an additional considerable saving of steel, the above specifications anticipate a series of concrete structural limitations pertaining to the use of steel construction.

For example, no steel columns are to be used in one-story industrial buildings equipped with cranes, where the center distance between columns is less than 12 meters, with the height of the column 12 meters and less. In buildings with spans up to 15 meters, supported by reinforced concrete and stone footings, with a center distance between columns up to 12 meters, no load-carrying metal roof structures are to be used. In buildings not subject to considerable dynamic

loads, in the presence of cranes with a lifting capacity up to 15 tons and a medium or light cycle of operations, or 5-ton cranes with a heavy-duty cycle of operations, steel crane-carrying beams are not to be used, unless they can be made from a a single rolled shape, etc.

In all the above outlined cases, the use of reinforced concrete or brick columns, reinforced concrete or wooden girders and arches, reinforced concrete (including stress-reinforced) crane-carrying beams, can be recommended.

The limits for the utilization of reinforced concrete structures replacing steel structures, as anticipated by the specifications, are stipulated by the lifting capacity and the height of lift of the construction cranes most widely in use, and also by the weight of the typical reinforced concrete structural assembly members, which are being used in our construction projects. It is, of course, understood, that with the rationalization of design, these limits can be considerably extended. For instance, the basic stem of the column may be made with an H-cross section or with a hollow rectangular cross section, obtained by vacuuming with the aid of a rigid core, which allows for the utilization of reinforced concrete columns in the presence of heavy crane loads. The column head may be either steel or reinforced concrete, butt-welded to the stem at the level of the crane-carrying girder support. In order to facilitate the build-up of the column heat butt-joint with the basic stem of the column, it is rational to

connect it, with the aid of a vertical diaphragm or an angle brace, to the crane-carrying girder support. Such a build-up will allow for the increase in the ultimate height, permissible in assembled reinforced concrete columns. Roofing over spans up to 30 meters may be effected over steel-reinforced concrete trusses, with assembled reinforced concrete upper struts and steel lower struts and lattice. Such trusses require twice as little steel as steel trusses, and, with the use of reinforced-concrete box-beams, the expenditure of steel for the roof, as a whole, is reduced almost three times.

Apartment and public buildings up to 14 stories (inclusive) high are to be built without a steel frame, with brick bearing walls and reinforced concrete or brick columns. The production of high-grade brick by our plants will permit the construction of the columns even for the lower stories of such buildings.

Multi-storied buildings with small roof loads for a number of branches of industry may also be of assembled or monolithic reinforced concrete construction. The mechanization for the construction of such buildings is provided by the use of a typical column network for the equal-height stories, by the designation of one or two column cross sections for the entire height of the building, etc. For those industrial buildings, where, due to technological considerations, no single-type roof design can be used on account of numerous openings, the presence of considerable concentrated loads, non-typical spans and heights of individual stories, etc., the use of a

steel frame is permissible.

The enumeration of the types of multi-story industrial buildings, requiring a steel frame, must be worked out by the respective Ministry and coordinated with the State Committee of the Council of Ministers of the USSR in Charge of Construction.

The steel frame of a building must by all possible means be relieved of load-carrying at the expense of lightening the enclosing structures and the transfer of the weight of the walls directly onto the footings. Hence, brick walls of single-brick thickness and above, up to a height of 15 meters, are to be self-supporting, they are to sustain the vertical load only, and to be connected with the frame by flexible connections which transmit the horizontal loads and do not inhibit the free settling of the walls. In transmitting the weight of the walls to the frame, light-weight types of masonry, multi-perforated porous brick, hollow slag-concrete and ceramic stones, etc., are to be used.

Roof coverings are to be made of reinforced foamy cement and reinforced foamy silica plates, of shrink-proof asbestos-cement (hollow and trough-shaped) plates, of reinforced cement multi-rib plates containing effective shrink-proofing (slag cotton plates, cement fibrolite, etc.). For the utilization of slag, as shrink-proofing, the use of light-weight granulated slag only is specified.

When designing metal construction, particular attention

should be paid to the savings in steel plate. In connection with this, it is recommended that the solid construction of columns, crane-carrying girders, load-carrying roof and ceiling members, in the absence of an aggressive environment, be substituted by a lattice construction. The braking connections for the crane-carrying girders are to be of lattice construction, with wooden bridging for passage. Smokestacks with a diameter in excess of one meter are to be made of brick and reinforced concrete, with the exception of stacks which are installed on roofs of buildings and technological furnace stacks. Silos and coal-handling towers (with the exception of suspension hoppers and chutes) are to be of reinforced concrete, with the use of lifting or adjustable sheathing. In the case of industrial buildings, the use of load-carrying pressed roof covering is forbidden. Also, the use of steel roofing for dwellings and public buildings is strictly limited.

In order to effect savings in reinforcing steel, the specifications anticipate the predominant use of hot-rolled and cold-flattened steel of recurrent shapes, welded netting from cold-drawn wire for use in concrete slabs, and welded skeletons for girders and columns. The use of the above indicated types of reinforcing steel makes not only for economy in steel and for less laborious reinforcing work, but also, in the presence of load-carrying welded reinforcing skeletons, it promotes savings in lumber by reducing the amount of sheathing and staging.

A considerable saving of steel can be effected in the erection of railroad, highway, and city bridges, and also plant transportation platforms, scaffold bridges, and gantries. For all these, reinforced concrete construction is to be widely used, as is already the case in the construction of the hopper-type stockading in blast furnace installations.

In addition to economizing on steel, all possible efforts should be made to effect savings in clinker cement. In order to accomplish this, losses of cement in transportation, delivery, and storage should be prevented, and, within the limits of the construction site, cement is to be transported in containers or in specially adapted automotive trucks or transfer cars.

In storaging cement, the intermixing of different grades is not permissible, since it leads to lowered efficiency. Hence, storage facilities for cement should be equipped with individual bins. To avoid spoilage, cement storage plants are to be located in dry places. No storaging of cement is allowed in any enclosure which is not specially adapted for that purpose.

The proper control over the expenditure of cement from the storage plant is effected through its release to the consuming client by weight-measuring. The concrete and solution formula are to be determined on the basis of a preliminary laboratory analysis.

In so doing, it is forbidden to increase the cement

content in the concrete formula for the purpose of accelerating the accretion of strength in the concrete. The latter may be accomplished through the use of solidification accelerants, steaming, electric-heating, and the like. No higher grade of concrete than the grade specified in the design is to be used. The latter is selected with due consideration given to the predetermined rate of progress of the projects in construction, within a time interval not to exceed 90 days.

The utilization of clinker cement [cinder blocks] for low-duty construction members in buildings is not permitted, as, for instance, for sub-flooring, where no machinery load is anticipated, for masonry walls in low-height dwellings and public buildings, for plastering walls of enclosures containing dry air, etc.

In the preparation of concrete and cinder blocks, economies in the expenditure of cement can be effected by improving the quality of natural gravel mixtures and slags by screening, refining, etc., and by packing the concrete through vibration, vacuuming, and steaming, and by treating the smaller assembly aggregates in autoclaves.

To reduce the consumption of concrete, it is recommended to use in massive construction members up to 20-25 percent (volumetrically) hard rock stones.

A reduction in the weight of structures and, consequently, an economizing of cement and steel may be attained by the use

of higher grades of concrete: for conventional structures not below 140, and for thin-walled structures not below 200.

Reinforced concrete is not to be used in structural members which carry no loads (for instance, in partitions, etc.).

Much attention must be paid to the economizing in structural timber and lumber, particularly in the southern forestless areas. To accomplish this, wooden parts of buildings (partitions, subflooring, etc.) are to be made of locally available materials. slag-and-gypsum mixture slabs and blocks, etc. In order to reduce the non-productive expenditure of wood, it is necessary to utilize the sawmill wastes in the preparation of structural details. The use of the coniferous variety of wood can be reduced by substituting the wood of the deciduous variety of trees, such as aspen, birch, alder, beech, linden, and poplar, for a number of structural members, such as rafters and joists, lattice-work and bracing, interior doors and boxes, partitions not abutting against exterior walls, excavation bracing, etc. By such practices, savings up to 10-12 percent of the general consumption of timber and lumber in construction can be effected.

The rotting of lumber in the warehouses and even in buildings results in considerable losses of materials and money. To overcome this evil, it is necessary to provide appropriate conditions for the storaging of lumber and for the long life of wooden buildings,

and parts of buildings. This is done by putting into effect constructive measures and by specifying the correct construction methods and procedures, and, when necessary, by the use of antiseptic and wood preservation procedures. Antiseptic and preservation procedures are to be pursued directly at the construction sites.

The consumption of lumber can be sharply reduced by providing for the repeat utilization of latticing in reinforced concrete work, of staging, and scaffolding, of excavation bracing, etc. Structures of great length, such as reinforced concrete tunnels, collectors, galleries, canals, and the like, are to be constructed by the assembly unit method or by the method of movable casings.

The wide use of glued wood construction is recommended. It permits the saving of wood, reduces the requirements for high-grade lumber and the lumber assortment sizes. A number of industrial, public, warehouse, and auxiliary buildings are to be designed for prefabricated structural members made of wood, such as glued-construction arches and beams, metal-and-wood trusses and beam assemblies, metal-free curved reticular arches, rafters and joists from low-grade material, etc.

The strict compliance with the above mentioned specifications will result in a considerable saving of structural materials without impairing the solidity and the durability of the buildings and structures.

It is understood that the concrete rules and recommendations, cited in the specifications, cannot embrace all the contingencies that may be encountered in construction. However, in such contingencies, the specifications clearly provide the direction, in which the work is to proceed, in order to provide the stupendous construction program of the Soviet Union with the materials needed for its fulfillment.